

Vehicle Shield Optimization and Risk Assessment of Future NEO Missions

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Future human space missions target far destinations such as Near Earth Objects (NEO) or Mars that require extended stay in hostile radiation environments in deep space. The continuous assessment of exploration vehicles is needed to iteratively optimize the designs for shielding protection and calculating the risks associated with such long missions. We use a predictive software capability that calculates the risks to humans inside a spacecraft. The software uses the CAD software *Pro/Engineer* and *Fishbowl* tool kit to quantify the radiation shielding properties of the spacecraft geometry by calculating the areal density seen at a certain point, dose point, inside the spacecraft. The shielding results are used by NASA-developed software, *BRYNTRN*, to quantify the organ doses received in a human body located in the vehicle in a possible solar particle events (SPE) during such prolonged space missions. The organ doses are used to quantify the risks posed on the astronauts' health and life using *NASA Space Cancer Model* software.

An illustration of the shielding optimization and risk calculation on an exploration vehicle design suitable for a NEO mission is provided in this study. The vehicle capsule is made of aluminum shell, airlock with hydrogen-rich carbon composite material end caps. The capsule contains sets of racks that surround a working and living area. A water shelter is provided in the middle of the vehicle to enhance the shielding in case of SPE. The mass distribution is optimized to minimize radiation hotspots and an assessment of the risks associated with a NEO mission is calculated. A cross section illustration of the vehicle initial design is shown in Figure 1.

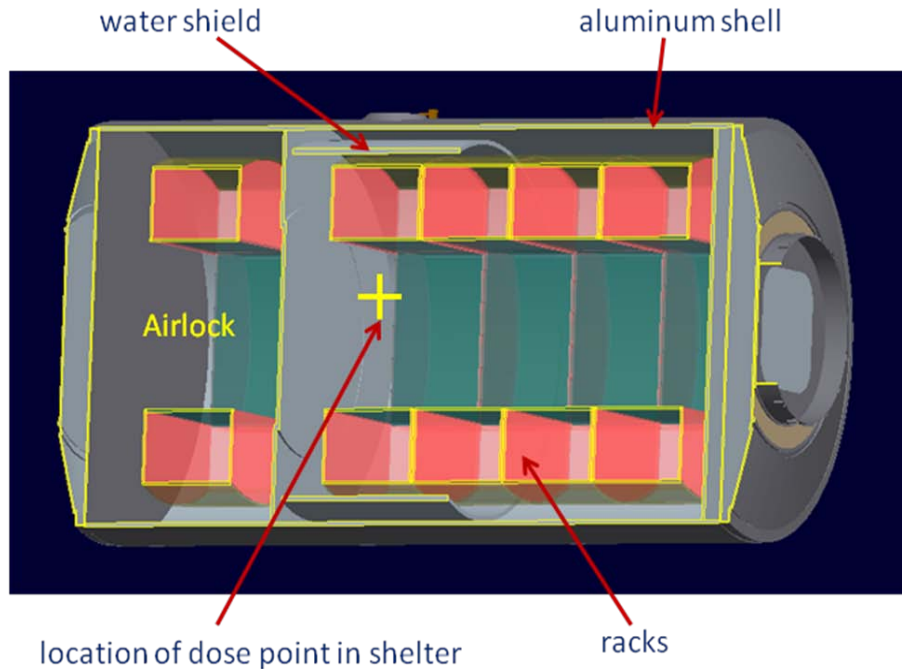


Figure 1. Cross section of the initial vehicle design